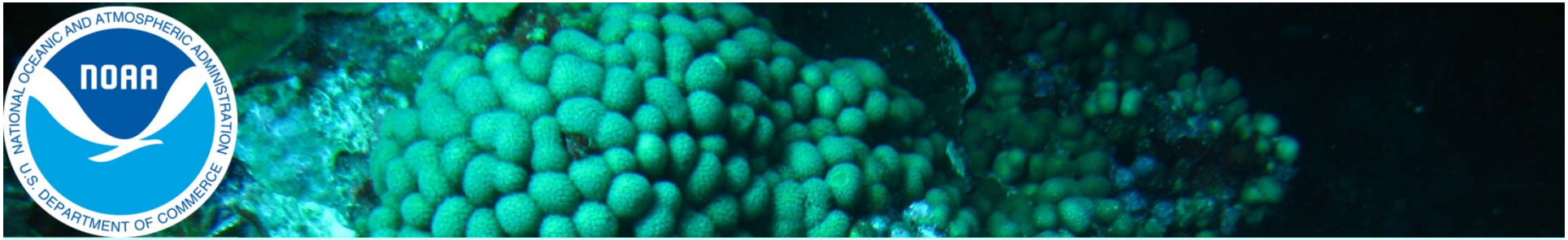

Mapping and analyzing the distribution of proposed endangered coral in Flower Garden Banks National Marine Sanctuary

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University of Rhode Island

B.S. Marine Biology

Goal: Healthy Oceans

NOAA NOS/NCCOS/CCMA/Biogeography Branch & CCFHR/Applied Ecology & Restoration Research Branch

Chris Jeffrey, Randy Clark, Christine Buckel, Shay Viehman

Outline

- Introduction
- Goal
- Methods
- Results
- Conclusion
- What's Next?
- Sources
- Acknowledgements

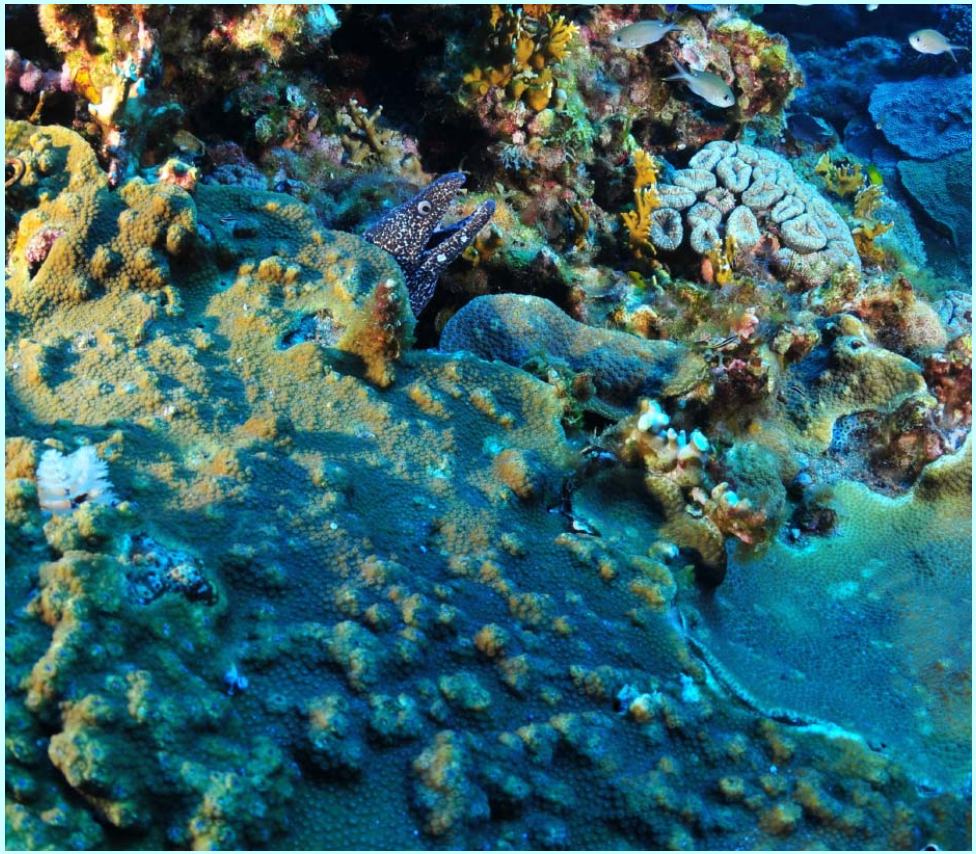


Photo courtesy of M. Winfield (UNCW)

What is NCRMP?

National Coral Reef Monitoring Program

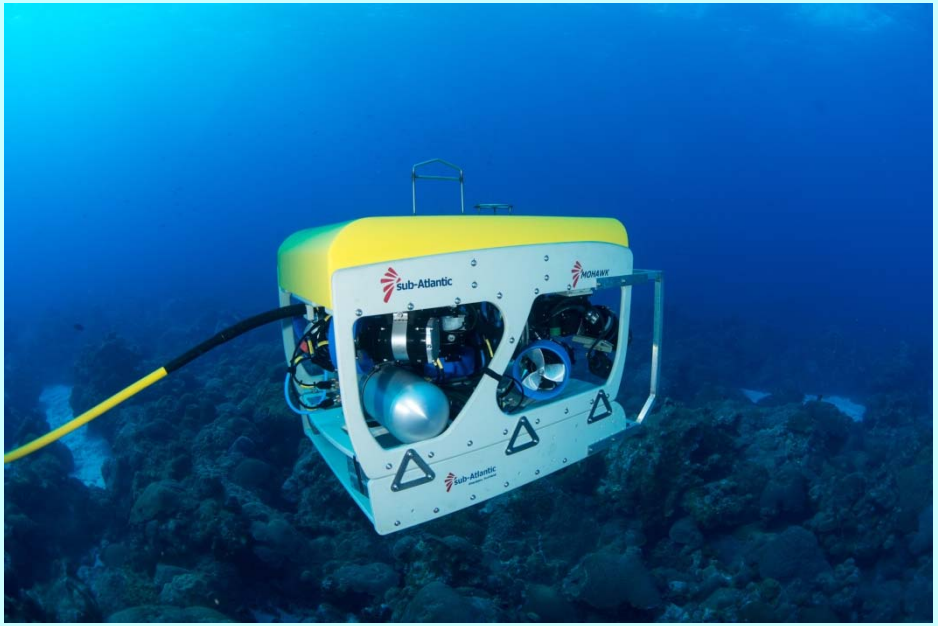
- Collaborative effort
- Funded by Coral Reef Conservation Program (CRCP)
- Long-term coral reef monitoring in four locations:
  - **FGBNMS**
  - FKNMS
  - PR
  - USVI
- Data collection & analysis
  - Water quality
  - Oceanographic conditions
  - Benthic habitat
  - **Biological communities**

Photo courtesy of NOAA

What is FGBNMS?

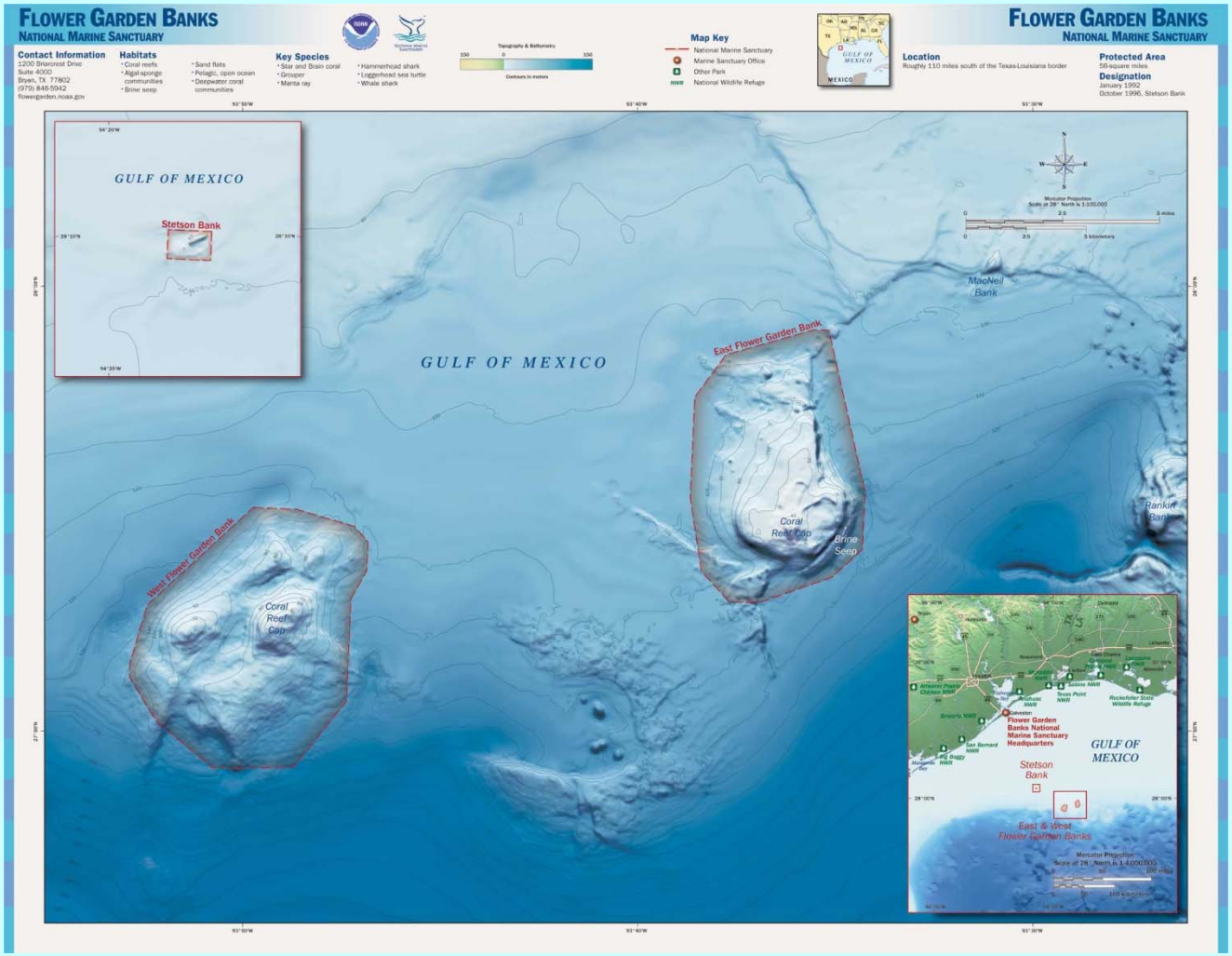
Flower Garden Banks National Marine Sanctuary

- Marine Sanctuary located 70 to 115 miles off the coasts of TX and LA
- Comprised of two banks
  - East & West
- Unusual Reefs
  - Deep reef
  - Reliefs
  - **High coral cover**



Mohawk ROV
Photo courtesy of FGBNMS

Map of FGBNMS



Map from FGBNMS Website

FGBNMS: High and Low Reliefs

High Relief

- Rugose boulder
- Reef building coral species

Photo courtesy of NOAA

Low Relief

- Less rugose
- Non-reef building species
- Deeper: 30-52 m

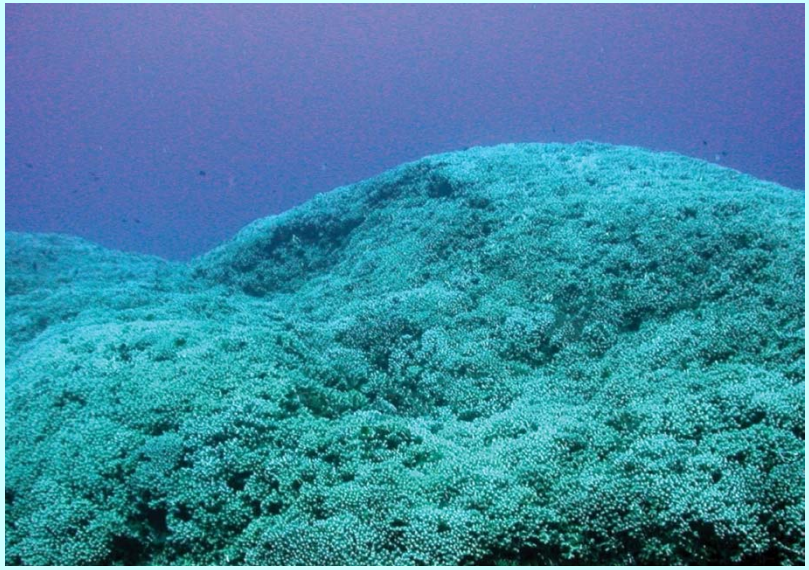


Photo courtesy of NOAA

Proposed ESA Coral

- Proposition to put **seven** on ESA list
- Threats that occur in the ocean
- The more vulnerable a coral species is to a threat, the higher importance that threat becomes
- June 2014?!

Threat	Importance	Section 4 Factor
Ocean Warming	High	E
Disease	High	C
Ocean Acidification	Medium-High	E
Trophic Effects of Fishing	Medium	A
Sedimentation	Low-Medium	A and E
Nutrients	Low-Medium	A and E
Sea-Level Rise	Low-Medium	A
Toxins	Low	E
Changing Ocean Circulation	Low	E
Changing Storm Tracks/Intensities	Low	E
Predation	Low	C
Reef Fishing—Destructive Fishing Practices	Low	A
Collection and Trade	Low	B
Natural Physical Damage	Low	E
Human-induced Physical Damage	Negligible-Low	A and E
Aquatic Invasive Species	Negligible-Low	E
Salinity	Negligible	E
African/Asian Dust	Negligible	E
Changes in Insolation	Probably Negligible	E

Table courtesy of Federal Register/Vol. 77, No. 236

ESA Coral

Photos courtesy of Wikipedia, FGBNMS, and the Australian Institute of Marine Science

Orbicella franksi

Acropora palmata

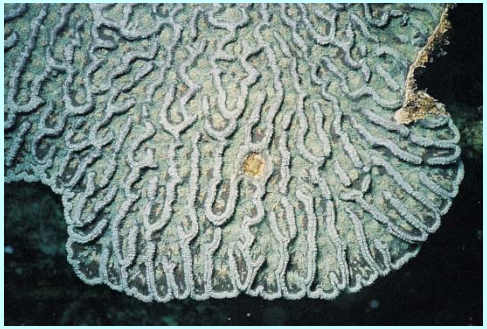
Orbicella annularis

Orbicella faveolata

Acropora cervicornis

Agaricia lamarcki

Dendrogyra cylindrus



Mycetophyllia ferox

Dichocoenia stokesii

ESA Coral

Photos courtesy of Wikipedia, FGBNMS, and the Australian Institute of Marine Science

Orbicella franksi

Acropora palmata

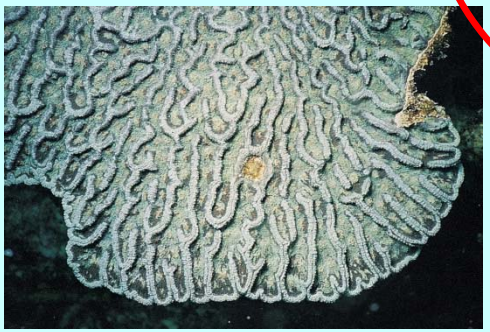
Orbicella annularis

Orbicella faveolata

Acropora cervicornis

Agaricia lamarcki

Dendrogyra cylindrus



Mycetophyllia ferox

Dichocoenia stokesii

Most abundant coral species?

According to NCCOS's report on FGBNMS for data collected in 2010-2012, **star corals** accounted for **65%** of the total coral coverage. Three out of five star corals are proposed endangered species.

Orbicella franksi = 43.5%

Orbicella faveolata = 10.8%

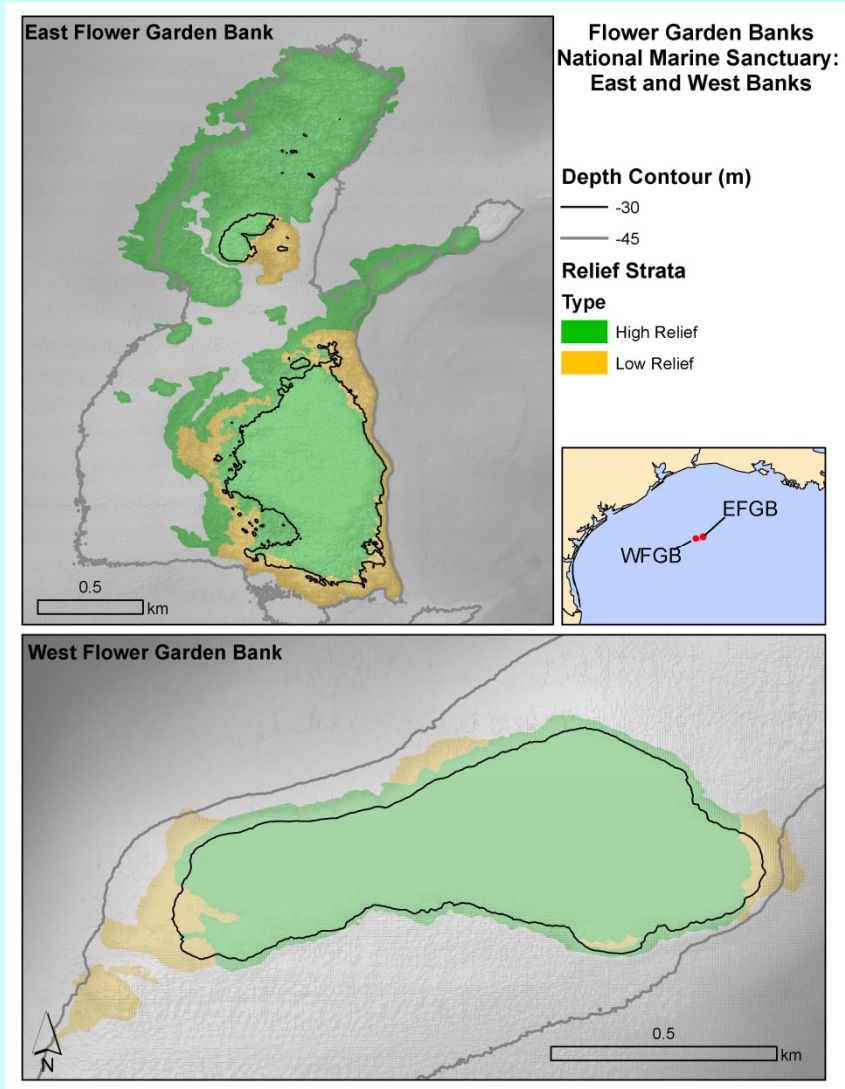
Orbicella annularis = 1.2%

Non-ESA star coral = 9.5%

Goal

Analyze and map the distribution of proposed ESA coral species and other general categories in FGBNMS collected in 2013 by:

- Bank (East & West)
- Relief (High & Low)
- Depth
- Rugosity



Map by Katharine Egan (URI)

Why?

- Long-term monitoring of reefs
- Protecting diverse ecosystems
- **Management decisions**

Methods
Diving

Fish Diver	LPI Diver	Demo Diver
Fish Survey (25m x 4m)	LPI Survey (20m)	Demographics Survey (10m x 1m)
Benthic Rugosity Survey (24m x 4m)	Key Species Survey (ESA) (25m x 2m)	

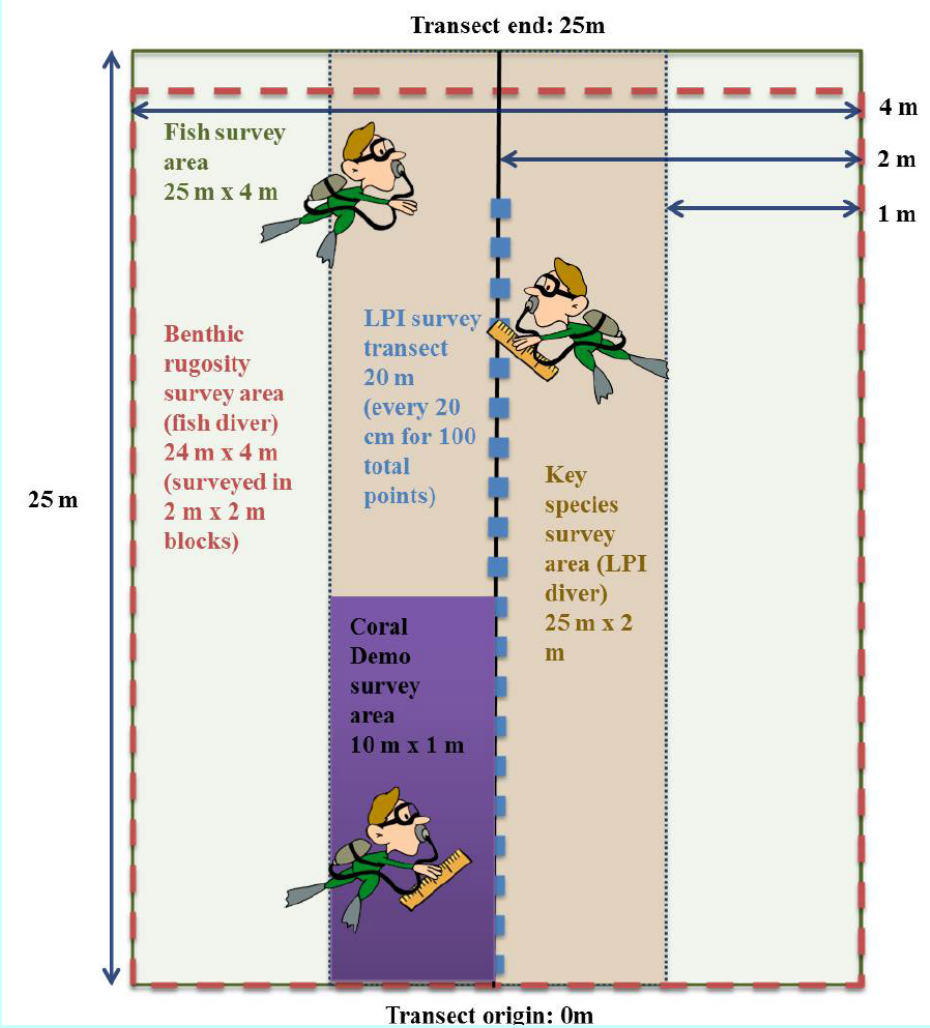


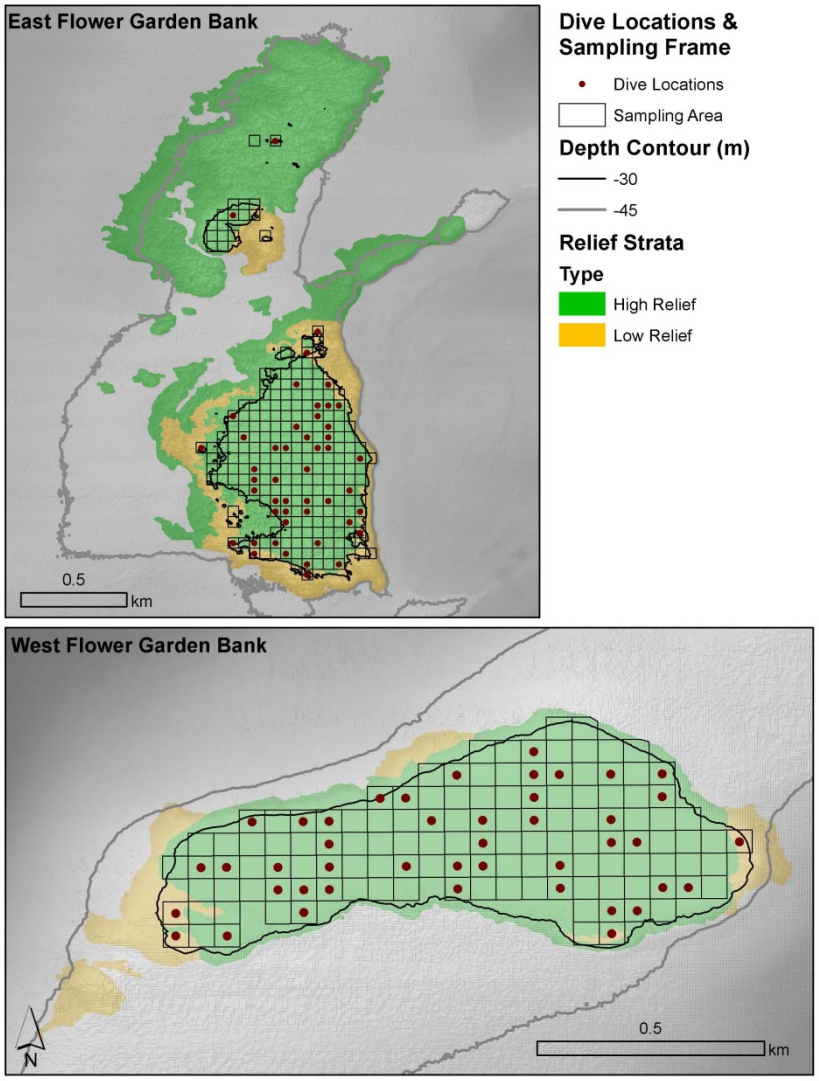
Diagram courtesy of Kimberly Roberson (NCCOS)

Methods
Mission to Puerto Rico

Photo courtesy of Kim Edwards (NCCOS)

Methods
Mapping

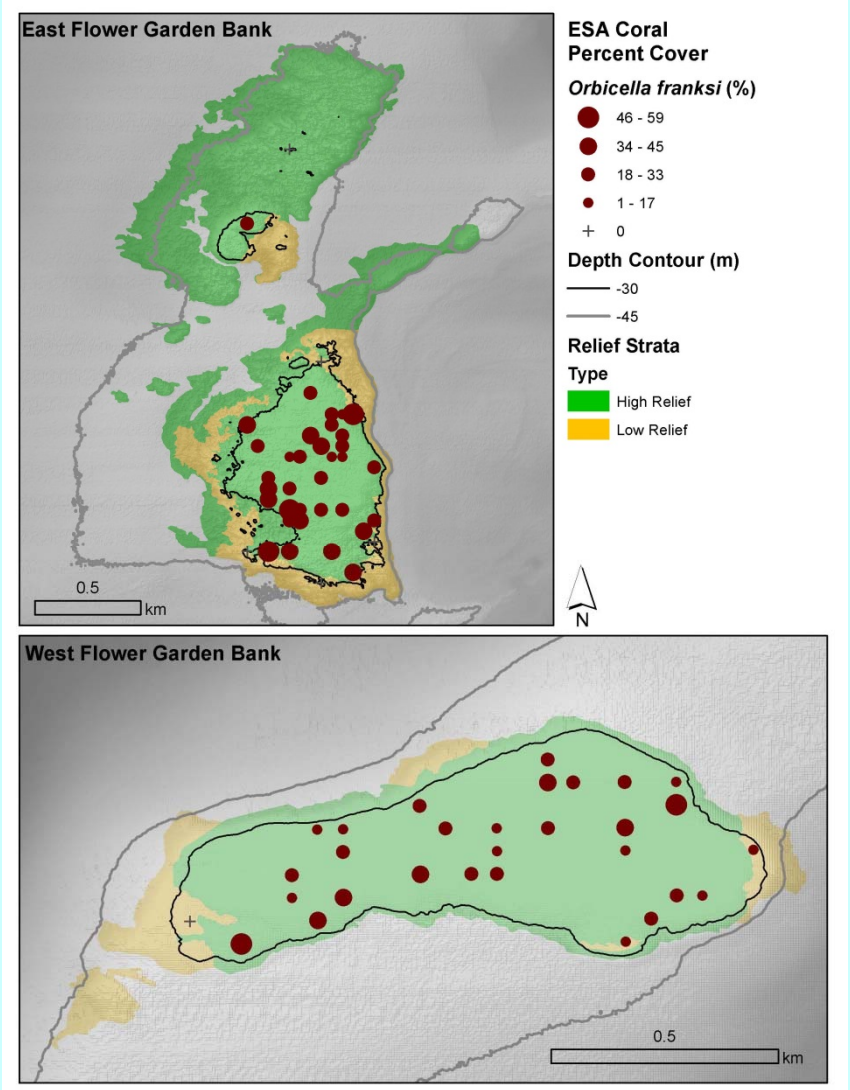
LPI Dive Locations in FGBNMS for 2013



Map by Katharine Egan (URI)

Methods
Mapping

LPI Data
Example: *Orbicella franksi*

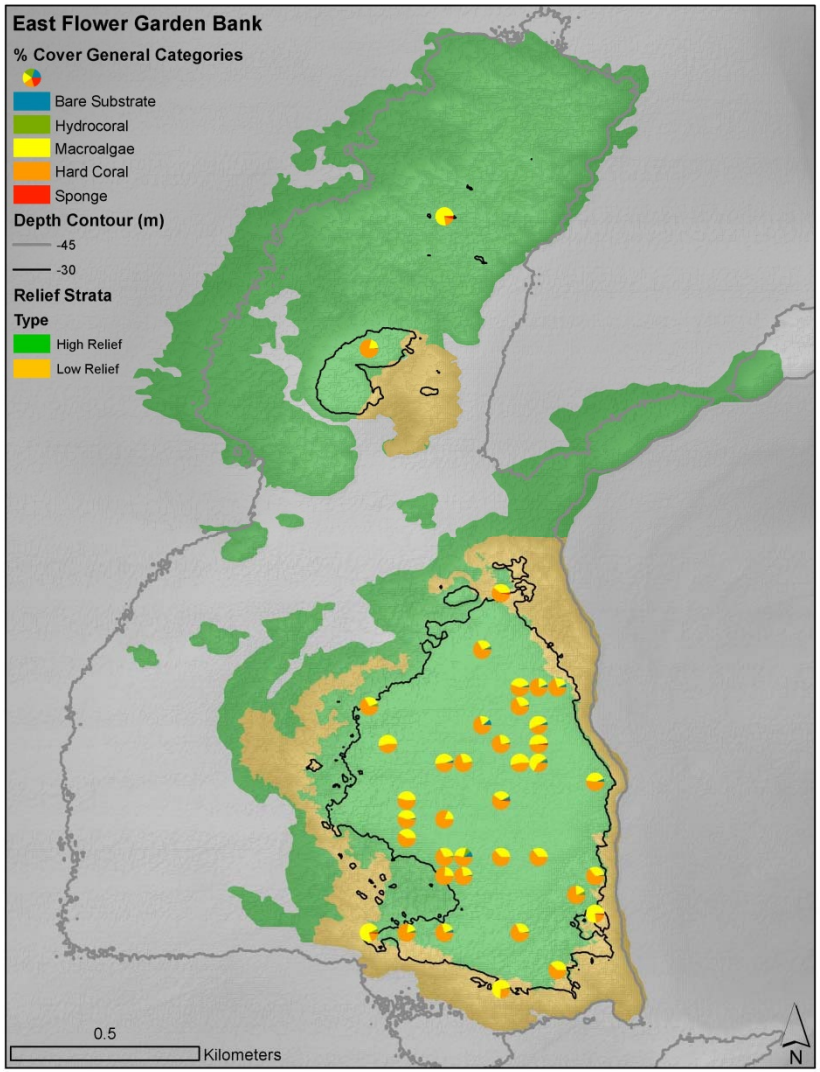


Map by Katharine Egan (URI)

Methods
Mapping

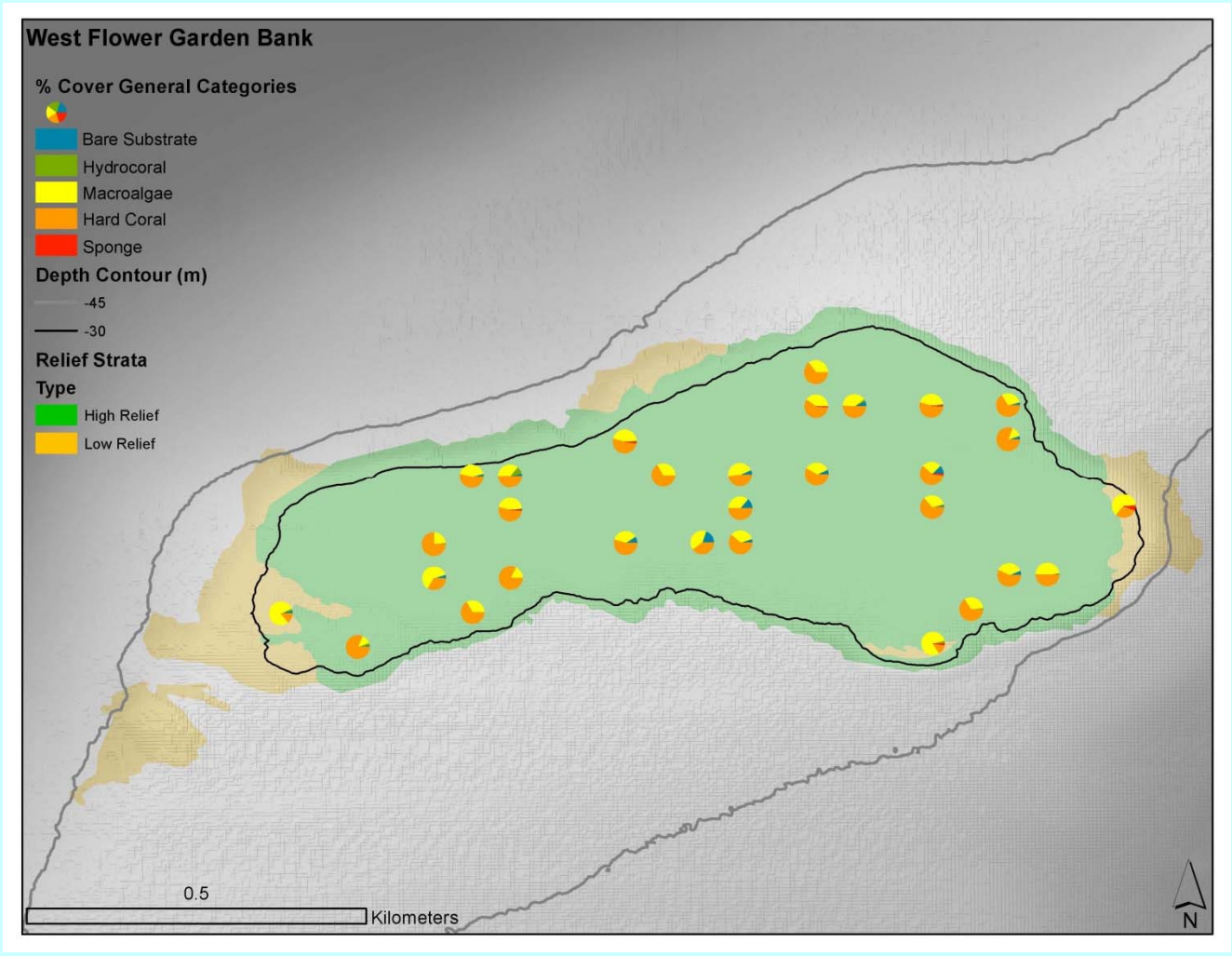
LPI Data General Categories:

- Hard Coral
- Macroalgae
- Hydrocoral
- Sponge
- Bare Substrate



Map by Katharine Egan (URI)

Methods
Mapping



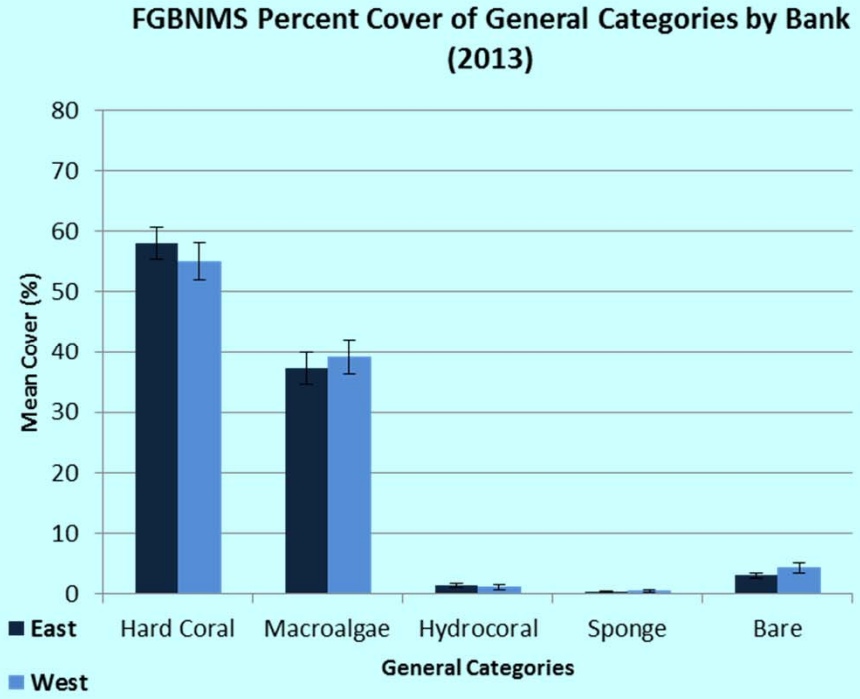
Map by Katharine Egan (URI)

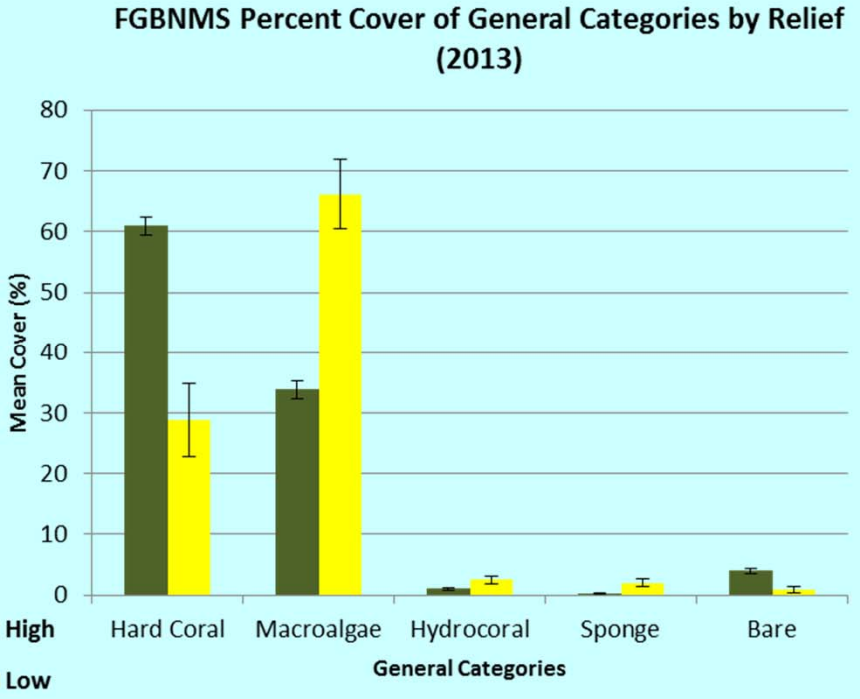
ArcGIS ArcMap 10.2 esri

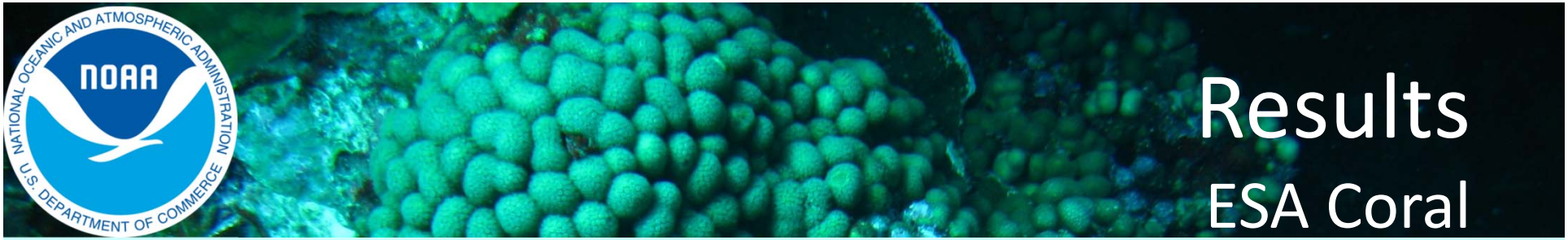
LPI Data General Categories:

- Scleractinian Coral
- Macroalgae
- Hydrocoral
- Sponge
- Bare Substrate

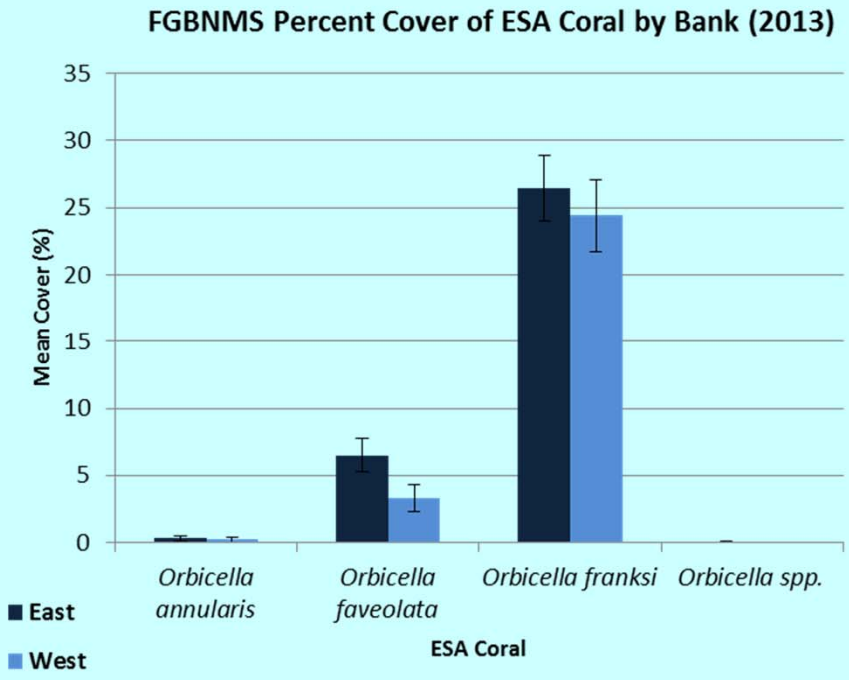
Results
General Categories

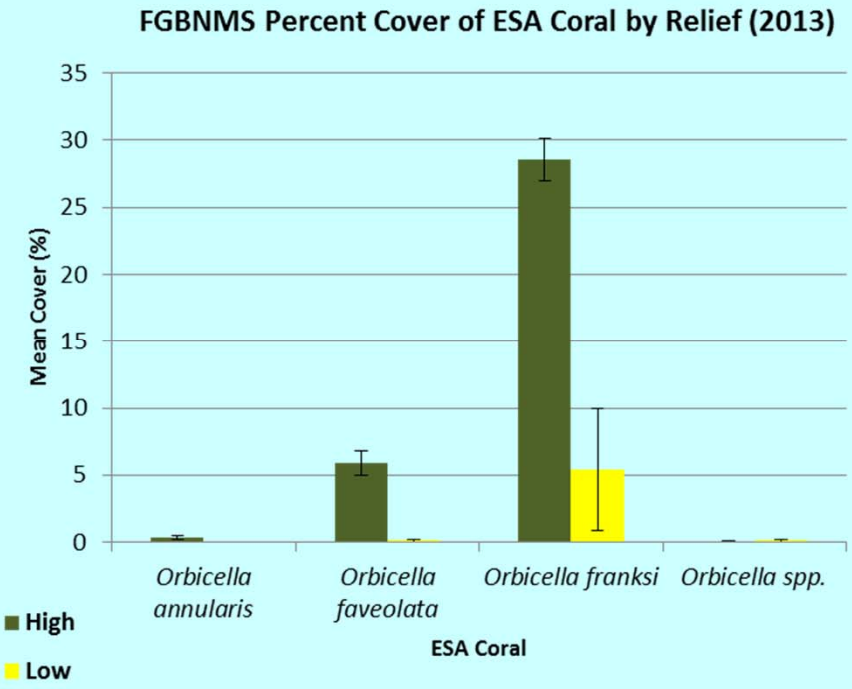


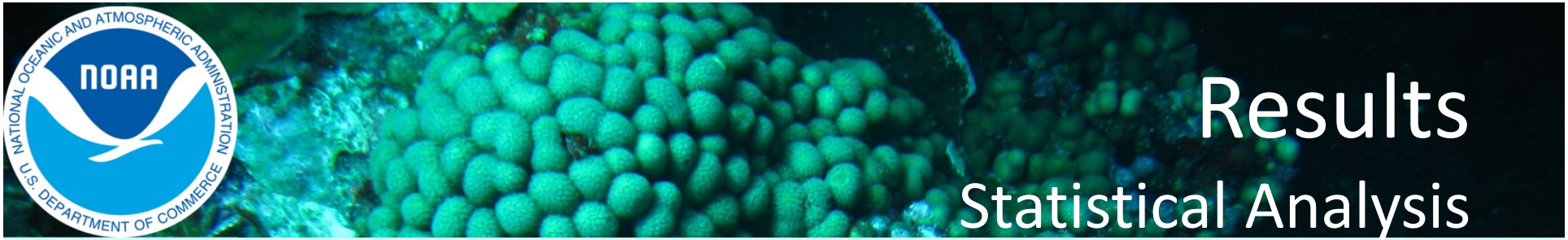




Results
ESA Coral







Results
Statistical Analysis

JMP	ESA Coral (LPI)	General Category (LPI)
High/Low Relief	Wilcoxon	Wilcoxon
East/West Bank	Wilcoxon	Wilcoxon
Depth (m)	Spearman's rho (ρ)	Spearman's rho (ρ)
Rugosity (m)	Spearman's rho (ρ)	Spearman's rho (ρ)

Results
General Categories Statistical Analysis

- Between Reliefs
  - All categories significantly different
  - More abundant in high relief areas
- Depth
  - Hydrocoral ($\rho = 0.2704$, $p = 0.0247$)
  - Positive correlation with depth
- Rugosity
  - All categories significantly different
    - Except hydrocoral
  - Bare Substrate and Hard Coral
    - Positive correlation
  - Macroalgae and Sponge
    - Negative correlation

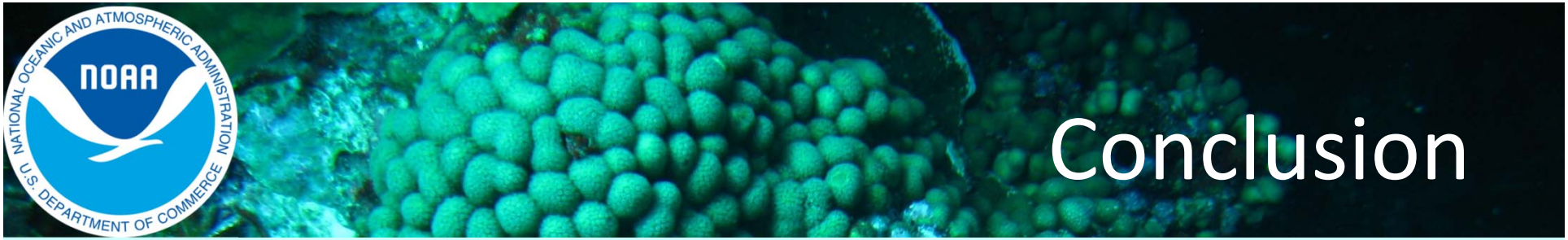
Photo courtesy of FGBNMS

Results
ESA Coral Statistical Analysis

- Between Reliefs
  - *O. franski*: (Z = -3.85923, p = 0.0001)
  - *O. faveolata*: (Z = -3.28799, p = 0.001)
  - More abundant on high relief
- Between Banks
  - *O. faveolata* (Z = -2.2213, p = 0.0263)
  - More abundant on the East bank
- Depth
  - *O. faveolata* (ρ = -0.2595, p = 0.0313)
  - Negative correlation with depth

Photo courtesy of FGBNMS

- **54% of all hard coral observed from the LPI survey was ESA coral**



Conclusion

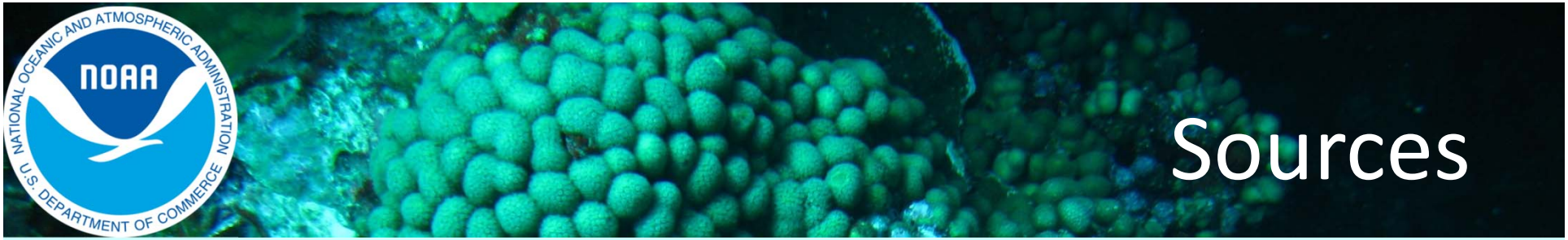
- **Results are congruent with previous research**
  - Coral reefs in FGB still dominated by coral
  - *Orbicella spp*. are the dominant hard corals
  - High reliefs still have high coral cover

- How is the reef changing over time?
  - Different from other Caribbean reefs
  - *FGB's coral communities are not declining*
    - More research needed

What's Next?

- More monitoring!
- Deeper monitoring?
- Publication
- Updating management plans for the sanctuary

Photo courtesy of FGBNMS



Sources

Clark, R., J.C. Taylor, C.A. Buckel and L.M. Kracker. 2014. Fish and Benthic Community Baseline Assessment of the Flower Garden Banks National Marine Sanctuary. DRAFT. NOAA Technical Memorandum NOS NCCOS 179. Silver Spring, MD. 310 pp.

Department of Commerce: National Oceanic and Atmospheric Administration: Endangered and Threatened Wildlife and Plants: Proposed Listing Determinations for 82 Reef-Building Coral Species; Proposed Reclassification of *Acropora palmata* and *Acropora cervicornis* from Threatened to Endangered. Federal Register, Vol. 77, No. 236, Pgs. 73220-73262. Retrieved July 22, 2014.

Picture on slide header courtesy of FGBMNS

Acknowledgments

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- Scholarship Team (Office of Education)

Photo courtesy of G.P. Schmahl (FGBNMS)

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